Online Appendix to: Welfare Impacts of Climate Risk Classification

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In Environmental and Energy Policy and the Economy, volume 7, University of Chicago Press, 2026

1 Endogenous Insurance Coverage with Risk Load

We extend the model in Section 3.4 by relaxing the constraint that homewoners must fully insure to qualify for a mortgage. Households now choose both the level of insurance coverage I and private investment in self-protection r. Insurers apply a risk load $\delta \geq 1$, so the premium per dollar of coverage is $\rho = \delta \cdot p \cdot \nu(r)$.

The household maximizes expected utility:

$$V(I, r) = p \cdot \nu(r) \cdot U(W_L) + (1 - p \cdot \nu(r)) \cdot U(W_{NL})$$

with:

$$\begin{aligned} W_L &= W_0 - RC + I - \delta \cdot p \cdot \nu(r) \cdot I - r \\ W_{NL} &= W_0 - \delta \cdot p \cdot \nu(r) \cdot I - r \end{aligned}$$

Households choose I and r to maximize V. Differentiating with respect to I:

$$\frac{\partial V}{\partial I} = p \cdot \nu(r) \cdot U'(W_L) \cdot (1 - \delta \cdot p \cdot \nu(r)) - (1 - p \cdot \nu(r)) \cdot \delta \cdot p \cdot \nu(r) \cdot U'(W_{NL})$$

This first-order condition implicitly defines the optimal insurance coverage $I^*(r)$, which is decreasing in δ. That is, the risk load leads households to purchase less than full insurance.

Differentiating with respect to r:

$$\frac{dV}{dr} = p \cdot \nu'(r) \cdot [U(W_L) - U(W_{NL})] + p \cdot \nu(r) \cdot U'(W_L) \cdot \frac{dW_L}{dr} + (1 - p \cdot \nu(r)) \cdot U'(W_{NL}) \cdot \frac{dW_{NL}}{dr}$$

where:

$$\frac{dW_L}{dr} = -\delta \cdot p \cdot \nu'(r) \cdot I - 1, \quad \frac{dW_{NL}}{dr} = -\delta \cdot p \cdot \nu'(r) \cdot I - 1$$

Substituting in, the first-order condition for r becomes:

$$\frac{dV}{dr} = -\left[\delta \cdot p \cdot \nu'(r) \cdot I + 1\right] \cdot \left[p \cdot \nu(r) \cdot U'(W_L) + (1 - p \cdot \nu(r)) \cdot U'(W_{NL})\right] + p \cdot \nu'(r) \cdot [U(W_L) - U(W_{NL})] = 0$$

This expression highlights the two opposing effects of the risk load. The term $\delta \cdot p \cdot \nu'(r) \cdot I$ implies that mitigation becomes more valuable as insurance becomes more expensive. However, the endogenous reduction in I reduces the marginal incentive to invest in mitigation. Under risk classification, this condition holds with p replaced by type-specific probabilities p^H and p^L, respectively. High-risk households typically choose higher coverage, reinforcing the incentive to invest in risk reduction.

2 Hypothetical landscape retrofit costs

The benchmark costs for our hypothetical landscape retrofit come from Barrett and Quarles (2024).

Replacing wood mulch: The reported all-in cost (including labor and overhead) of removing mulch within five feet of the structure and replacing it with pea gravel to a depth of 3 inches is \$463 per cubic yard of installed gravel. Assuming a square building footprint, the number of cubic yards required is,

$$[4 \times 5 \times \sqrt{(}FootprintArea) + 4 * 5 * 5] \times (1/4) \times (1/27)$$

where FootprintArea is the building footprint in square feet and noting that there are 27 cubic feet in a cubic yard. We calculate the footprint area for homes in our sample by dividing the square footage of the home by the number of stories. For a small number of homes with zero reported square footage, we impute square footage with the sample mean.

Replacing wooden fence: We assume that the homeowner replaces ten linear feet of wooden fence with a height of six feet. The reported all-in cost of demolition, disposal, new materials, and construction of a fiber cement fence is reported to be \$60.44 per square foot of new fence, yielding a fence upgrade cost of \$3,626.

For the median home in our sample, the total cost of the full landscape retrofit (mulch replacement and fence replacement) is \$7,665. The 10th and 90th percentile costs are \$6,822 and \$8,899.

Appendix Table 1: Analysis Sample vs. All California Zip Codes

	In-sample Zip Codes	All California Zip Codes
Total Single Family Homes	2,811,425	9,446,995
Wildfire Risk Scores		
Share ≤ 50	0.61	0.84
Share 51−60	0.12	0.04
Share 61−80	0.15	0.05
Share 81−100	0.12	0.06

Notes: Left column includes 400 zip codes in the wildfire risk dataset. Right column includes all California zip codes.

Appendix Table 2: Demographic Differences for Occupants of Single Family Homes

	Household Income (1)	Homeowner (2)	White (3)	Hispanic or Latino (4)	Limited English (5)
Single Family Detached Home	72,749.1***	0.531***	0.089***	-0.068***	-0.050***
	(2,237.7)	(0.006)	(0.005)	(0.005)	(0.003)
PUMA FE	✓	✓	✓	✓	✓
Observations	13,699,816	13,699,816	13,699,816	13,699,816	13,699,816
Dependent variable mean	132,195.6	0.56	0.47	0.31	0.09
R^2	0.15	0.34	0.16	0.18	0.05

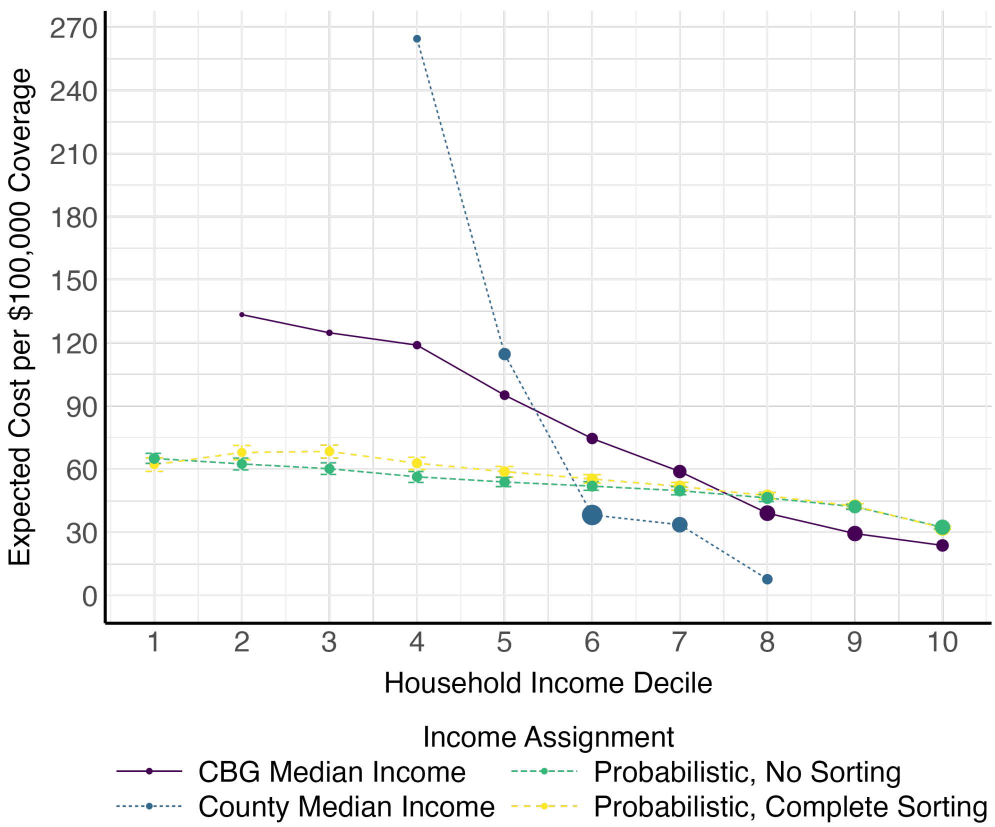
Notes: Table reports five separate OLS regressions of household characteristics on an indicator variable for single family detached home. Data come from the 2023 ACS Public Use Microdata Sample (PUMS) for California. All regressions include Public Use Microdata Area (PUMA) fixed effects. "White" and "Hispanic or Latino" are indicators for whether the householder is White Alone or Hispanic/Latino, respectively. "Limited English" is an indicator for whether any member of the household has limited English-speaking ability.

Appendix Table 3: R^2 for various Wildfire Risk Variables

Risk Variable	R^2
Wildfire Risk Score	0.15
County	0.29
Zip Code	0.48
Census Block Group	0.74
1 km grid	0.90

Notes: Table reports overall R^2 values from separate OLS regressions of average annual wildfire losses per $100,000 of coverage on risk class dummies using different classification methods.

Appendix Figure 1: Income Assignment Based on Area Median Income



Notes: Figure compares the methods used to assign income to homes in our data to results from assigning each home its CBG-median or county-median income.